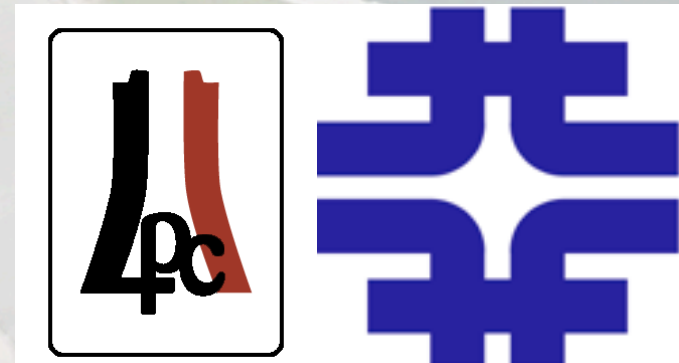







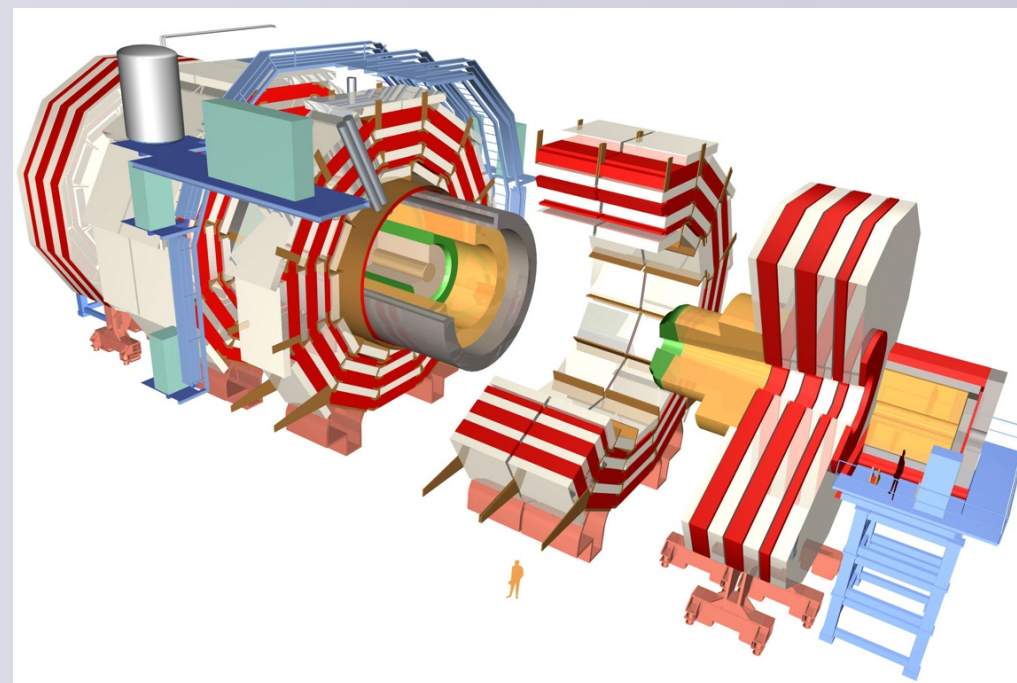
The LHC Physics Center at Fermilab

Fermilab Users Meeting
June 1, 2006







Kevin Burkett (FNAL)
for the LPC members



-  What is the LPC?
-  Goals of the LPC
-  LPC working groups and activities
-  ROC and LHC@FNAL
-  Conclusions

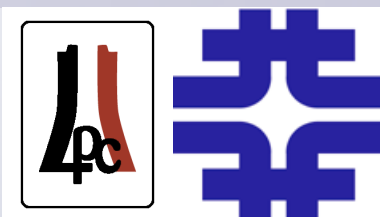


What is the LPC?

-  In short, we want to replicate the atmosphere of the CDF/D0 trailers here at Fermilab for USCMS collaborators
-  Why do people gather in the trailers?
 -  For some, it is to take shifts or maintain hardware. But for most, it is not directly connected to the proximity to the detector
 -  Want to stay informed of the status of the experiment
 -  Direct access to software or detector experts
 -  Give talks, get feedback, etc.



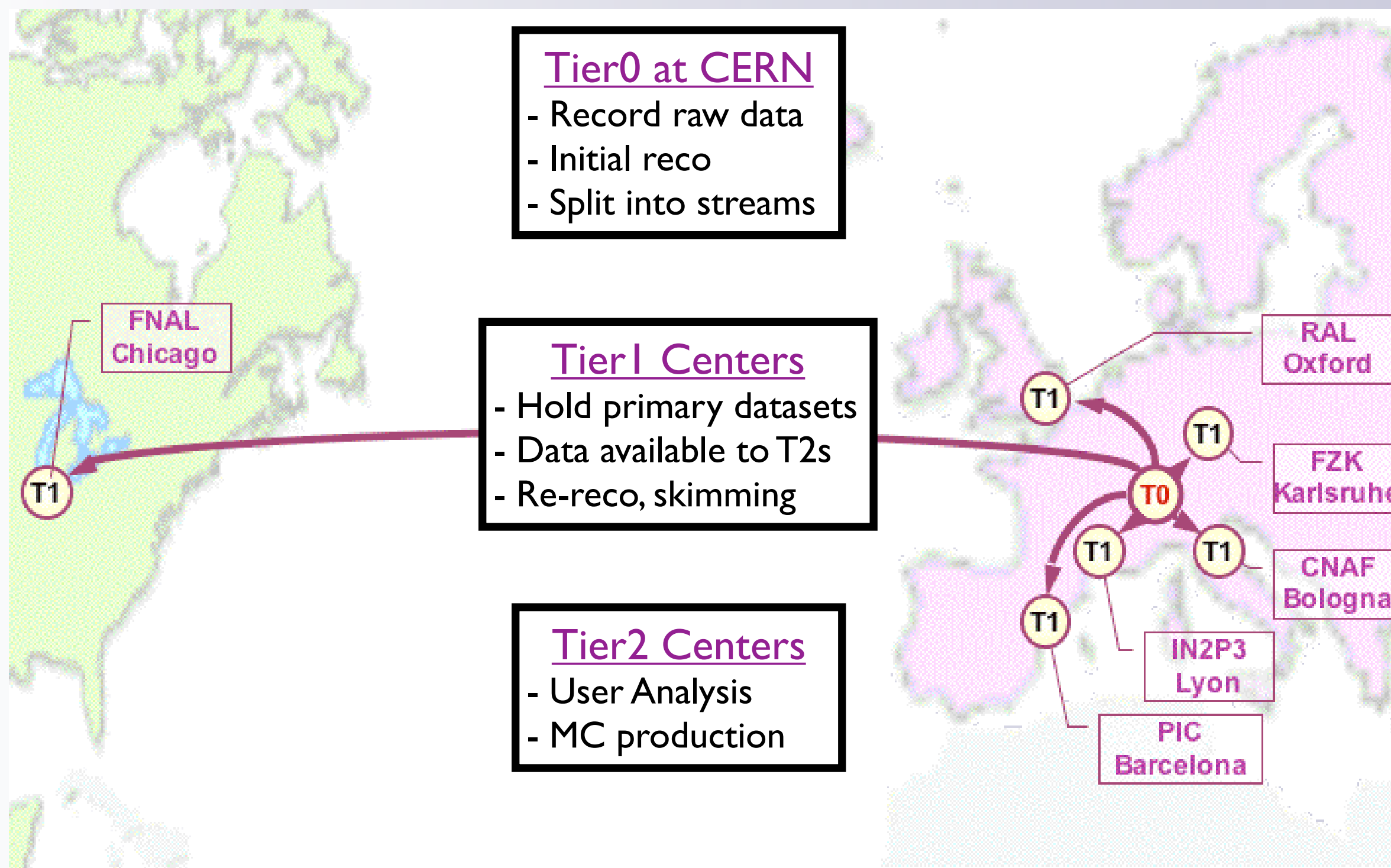
Goals of the LPC



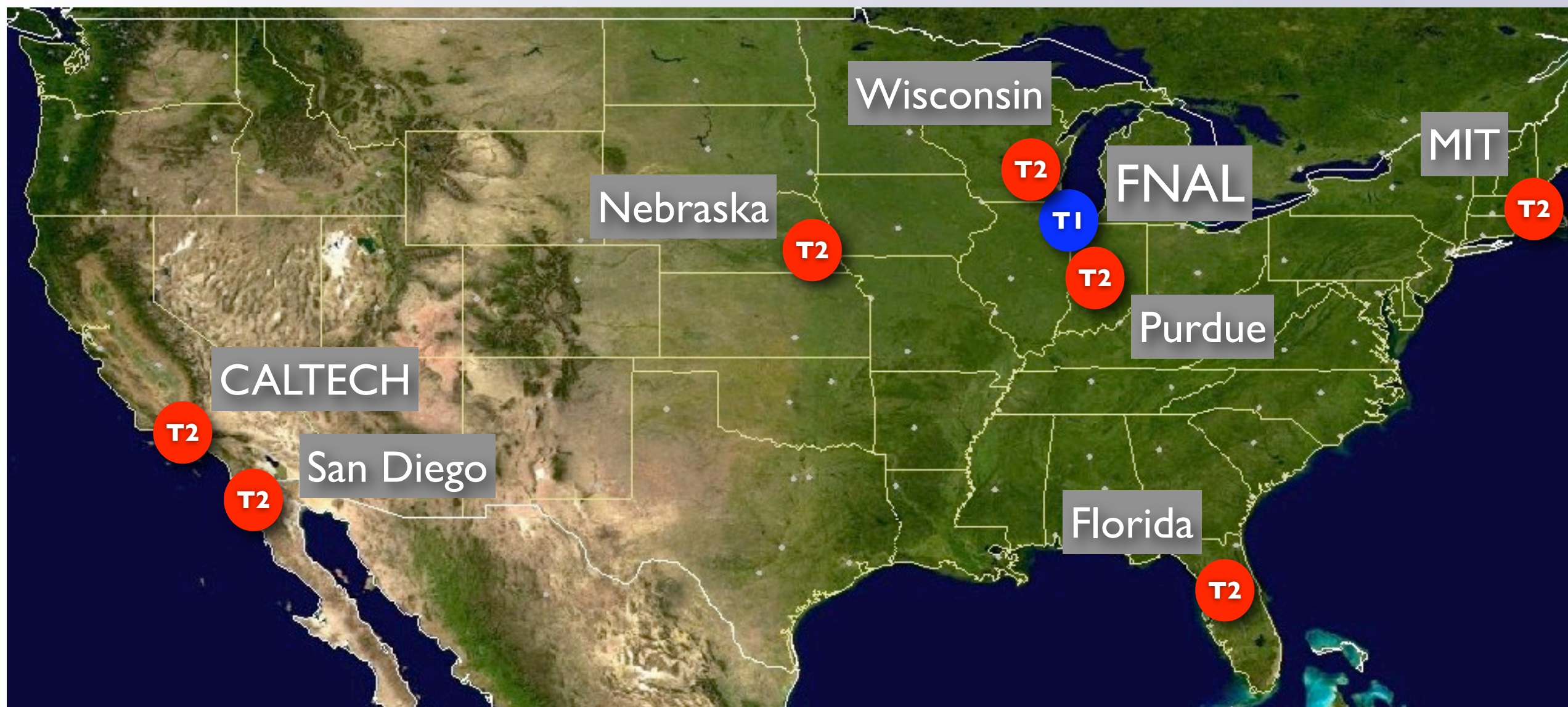
The purpose of the LPC is to ensure the US gives the strongest possible assistance to international CMS in software preparations for Day 1 and to enable physics analysis from within the U.S.

- a critical mass of people working actively on software, clustered in a single location
- a resource for university-based USCMS collaborators; a place to find expertise **in their time zone** or to visit with software or analysis questions
- a brick-and-mortar location for US-based physics analysis, with substantial physical infrastructure to support associated activities
- a remote center so that USCMS physicists can participate in data taking and quality control for CMS while in the US
- a tool to improve the transition between the Tevatron and LHC experiments for those physicists participating in both, maximizing the manpower available to each

Data samples will be distributed around the world



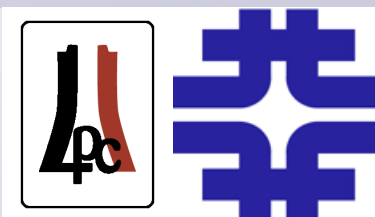
- 📍 FNAL has largest Tier I (~twice the size of others)
- 📍 Seven Tier2 centers attached exclusively to FNAL



Fermilab is in a strong position to take advantage of expertise of local experts in data handling, etc.



A brief history of the LPC

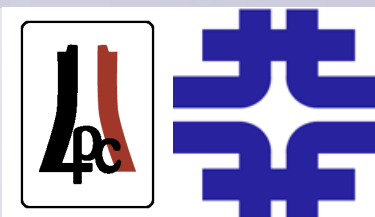


- First proposed by Dan Green in 1999
- Written proposal to director in February 2004
- Approved by the director in April 2004 under the direction of Sarah Eno and Avi Yagil
- First working groups formed Summer 2004, but no central location yet
- Moved into current location on 11th floor of Wilson Hall in January 2005









LPC Working Groups



Working groups form the core of the LPC

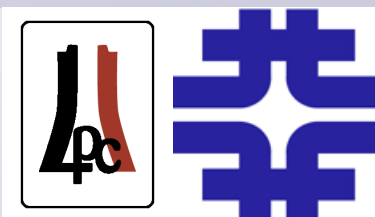
-  Focus of the groups so far has been on the environment and object reconstruction that will allow us to do physics later
-  Groups were formed to match CMS group structure in Computing/Physics/Trigger (CPT) project

Working groups have two primary responsibilities:

-  Contribute to the corresponding group in CMS
-  Provide expertise and training for USCMS physicists getting involved in CMS











LPC working groups



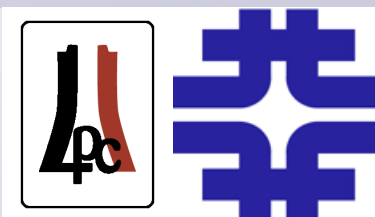
Current Working Groups

-  Offline/EDM: Liz Sexton-Kennedy (FNAL), Hans Wenzel (FNAL)
-  e/gamma: Yuri Gershtein (FSU), Colin Jessop (Notre Dame)
-  Jet/MET: Rob Harris (FNAL), Marek Zielinski (Rochester)
-  Muons: Eric James (FNAL), Michael Schmitt (Northwestern)
-  Simulation: Harry Cheung (FNAL), Daniel Elvira (FNAL)
-  Tracking: Steve Wagner (Colorado), Kevin Burkett (FNAL)
-  Trigger: Greg Landsberg (Brown), Kaori Maeshima (FNAL)
-  Recently added:
 -  Physics (Boaz Klima), Taus (Alexei Safonov, Anna Goussiou)





-  LPC working groups provide a platform for work on the foundations of future CMS physics analysis
-  This means working with all the components that go into a physics analysis
 -  Designing trigger strategy
 -  Running and improving simulation
 -  Developing reconstruction algorithms
 -  Samples needed to understand the data
-  Close proximity of groups promotes understanding of interplay between objects
 -  e.g. tracking for electrons and muons



LPC Jet/MET group



As an example of the work in one of the LPC groups,
look at the activities of the Jet/MET group

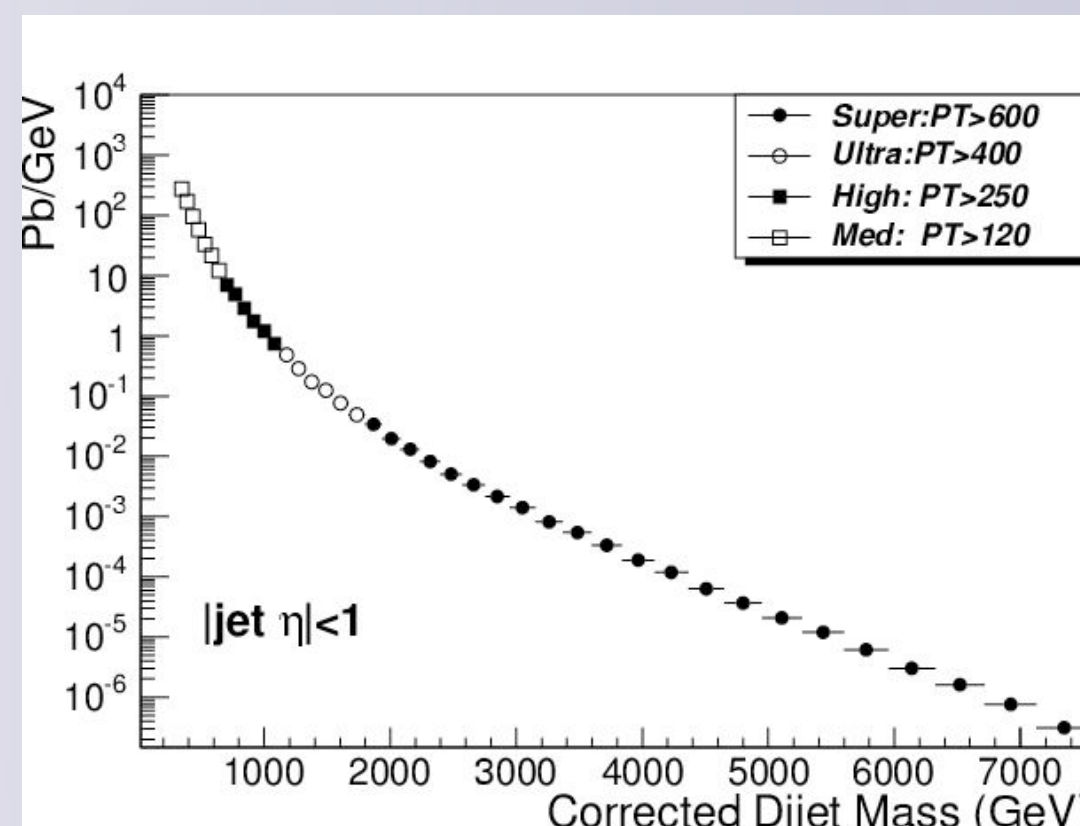
-  Developing trigger strategy
-  Algorithm development
-  Software engineering
-  Simulated physics analysis

Designing Trigger Strategy

- Define single jet trigger thresholds and prescales
- plan for evolution with increasing luminosity
- Driven by needs of future physics analyses
- Collaboration with LPC and CMS trigger groups

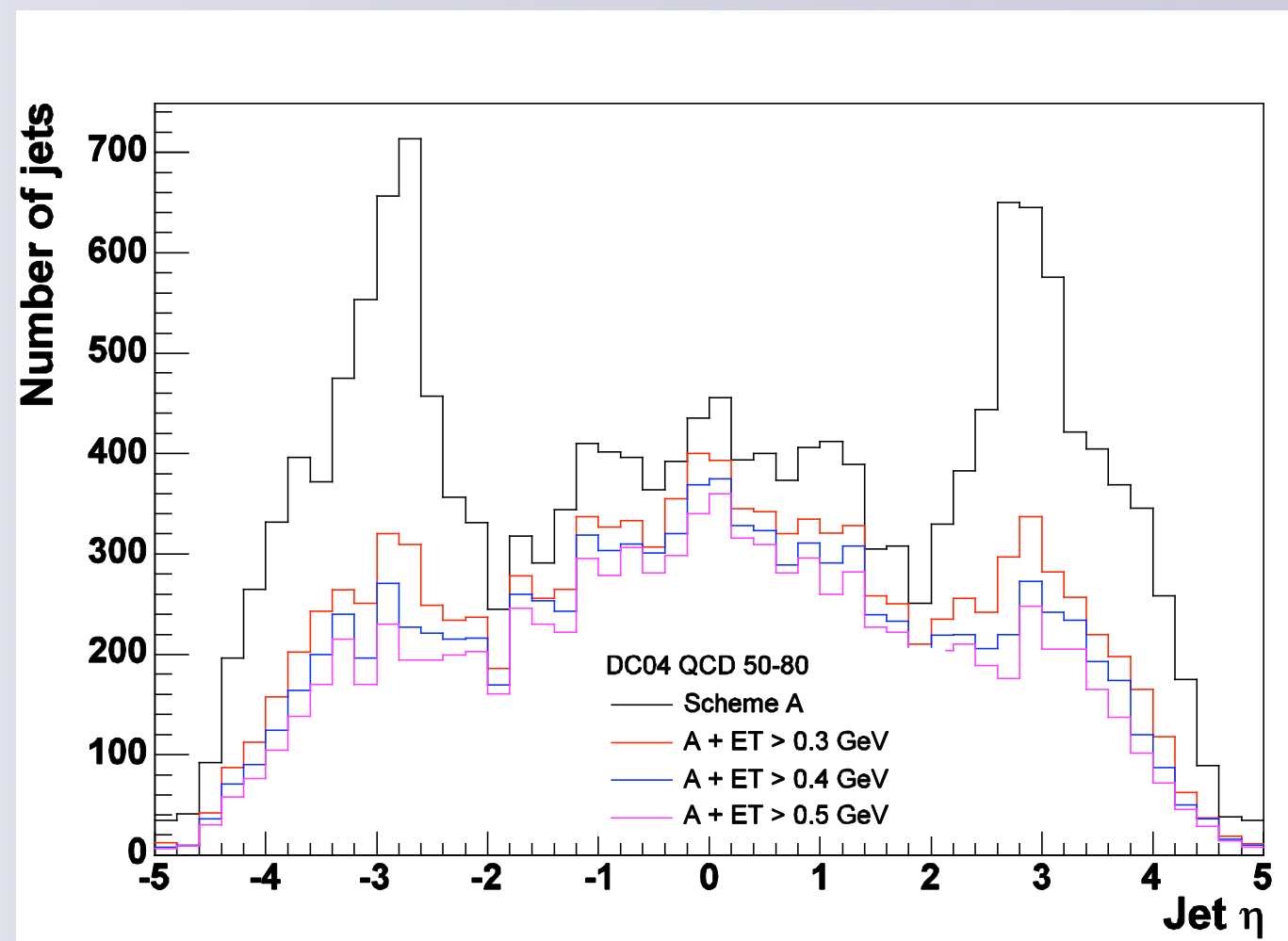
Single Jet Trigger Table for $L = 10^{32}$

Path	L1			HLT	
	E_T (GeV)	Pre-scale	Rate (KHz)	E_T (GeV)	Rate (Hz)
Low	25	2000	0.146	60	2.8
Med	60	40	0.097	120	2.4
High	140	1	0.044	250	2.8



Algorithm Development

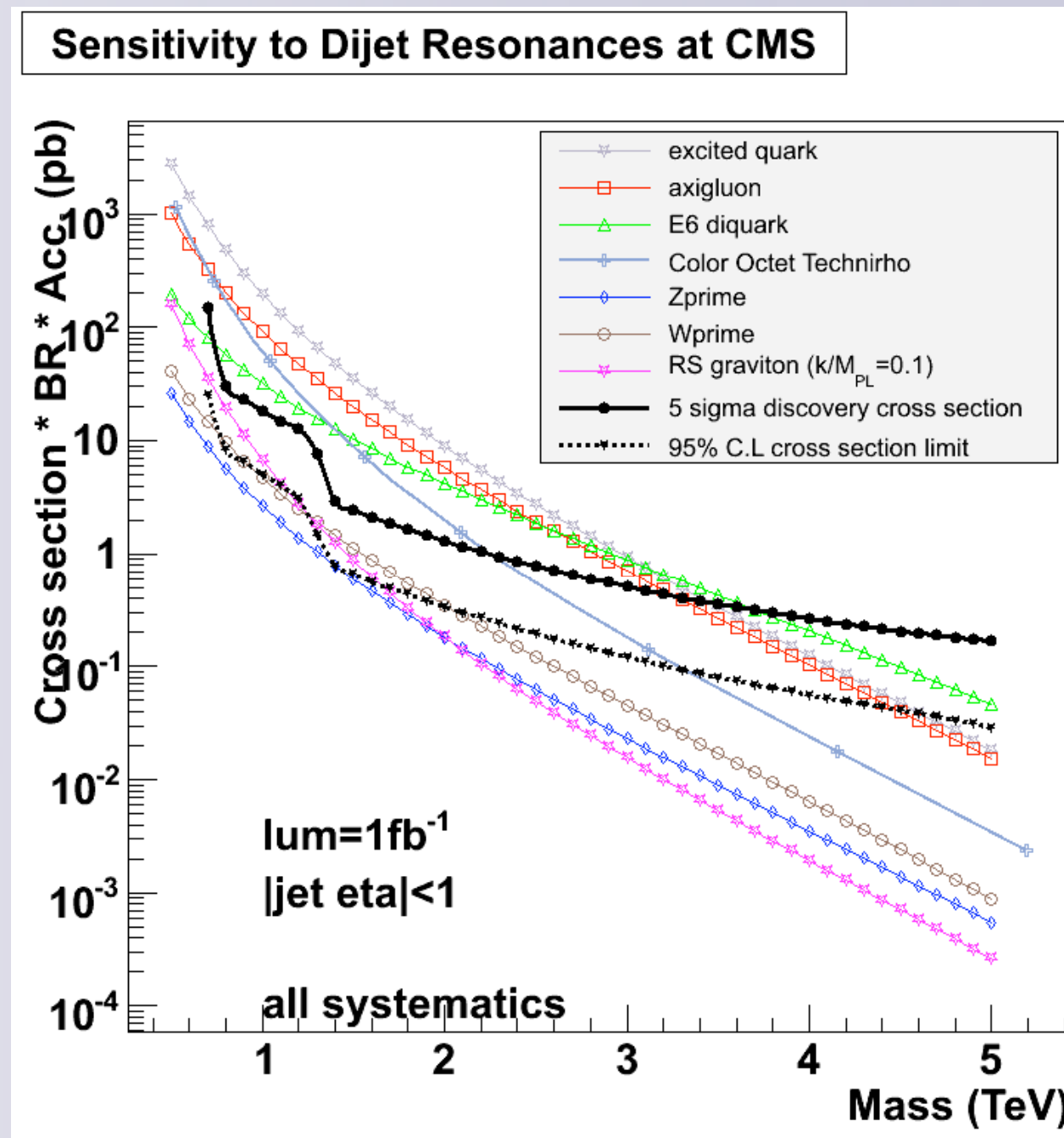
- Improved algorithm:
- new calorimetry thresholds for efficient noise suppression
- Noise/jet substantially reduced, while loss of real jet energy smaller than with often-used thresholds
- Adopted for use in CMS reconstruction



Important for analyses with low p_T jets such as qqH , ttH

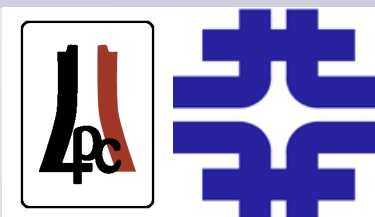
Preparing for Physics Analysis

- Many signals of new physics could appear in dijets
- W' , Z' , RS graviton, excited quarks, etc.
- Use full detector simulation
- Apply trigger table
- Estimate sensitivities at benchmark integrated luminosities ($0.1, 1, 10 \text{ fb}^{-1}$) including systematics





LPC Software Development







LPC Groups have played a major role in CMS software

- Offline/EDM group led review of framework and within months had an implementation of new framework
- Several LPC groups have taken leading roles in reconstruction software development in the new framework

Many other ongoing software projects

- Simulation group leading simulation validation effort
- New algorithms under development by muon, e/gamma, and tracking groups

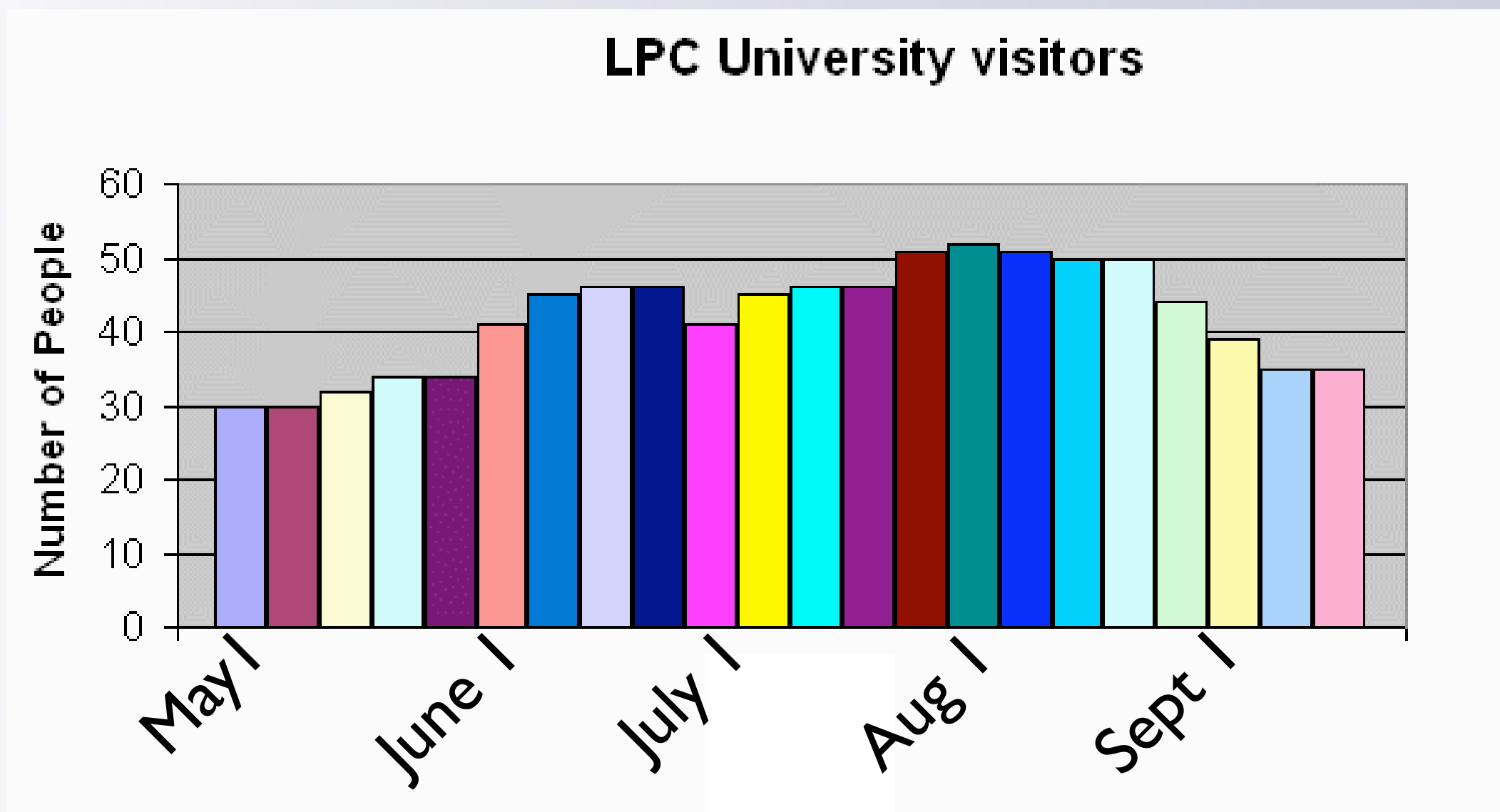
Many opportunities for information, education:




-  4 well-attended sessions of CMS101 to introduce new collaborators to CMS detector, software, local expertise
-  Several hands-on software tutorials
-  Mini-workshop on first two years of LHC Physics led by Michelangelo Mangano
-  J-Term in January to give an in-depth introduction for 1st and 2nd year grad students
-  4 Tevatron/LHC workshops and many detector workshops
-  Weekly All USCMS meeting



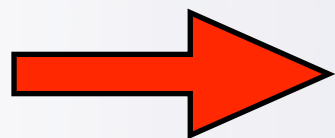
The LPC is not just for Fermilab people

Substantial (and growing) university presence



-  LPC is heavily involved in software development
-  Starting to turn toward preparations for physics
-  Want to be connected to data-taking and monitoring data quality

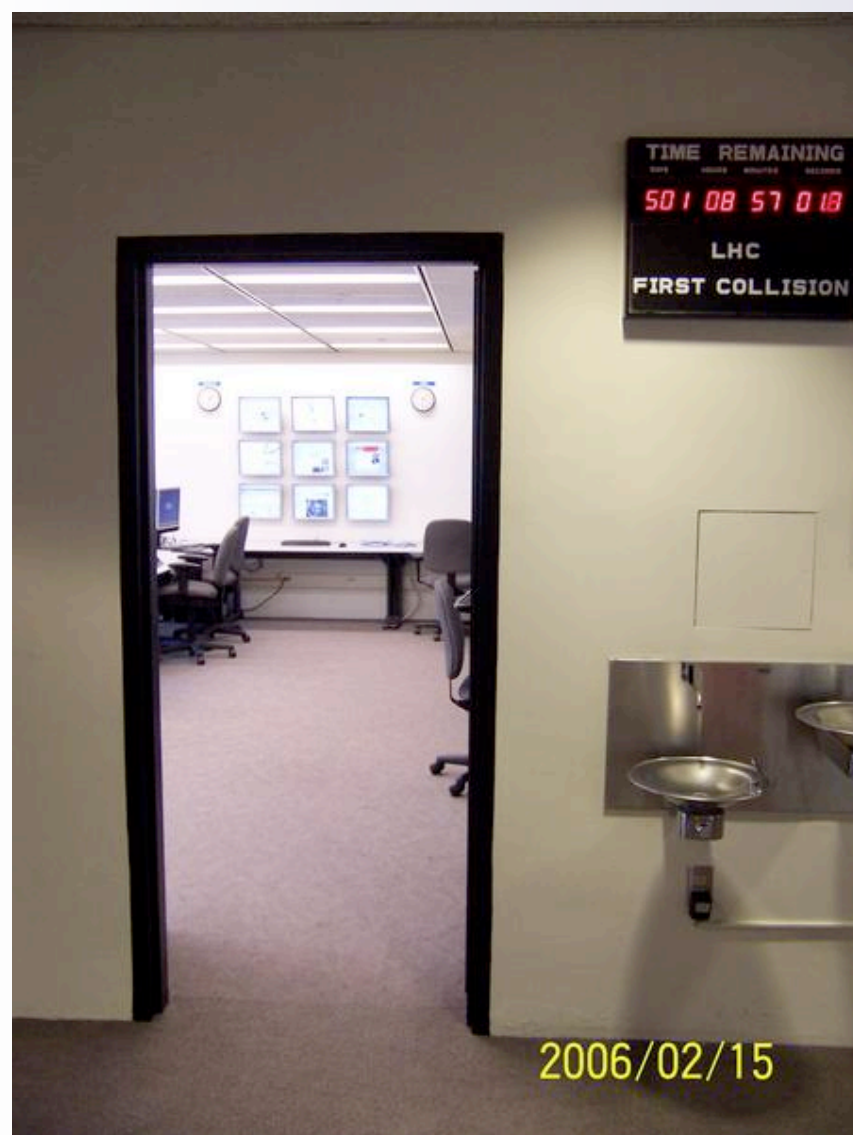
Support USCMS collaborators who have built and need to maintain parts of the detector



Remote Operations Center
“The ROC”

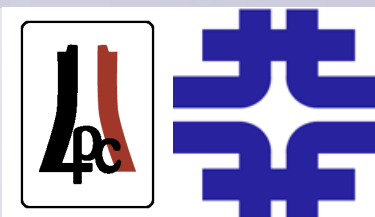


- 📌 Remote Operations Center - WHI INW
- 📌 Use for remote monitoring of CMS data-taking
- 📌 Infrastructure completed last September





ROC at FNAL

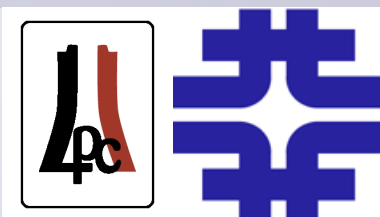


- ➊ Purpose of ROC is to monitor CMS data in as close to real-time as possible and feed back findings to CMS control room to support high quality and high efficiency data-taking
- ➋ Viewing output of DQM locally in real-time
- ➌ Expect monitoring shift operation at ROC
 - ➍ CDF planning remote monitoring shift
- ➎ Allows detector experts in US to take part in data quality monitoring

CERN is proposing to build a ROC at Meyrin



ROC at FNAL



Summer plans for ROC are to take part in monitoring data during Cosmic Challenge

- 📌 All data from MTCC (multiple streams) will be transferred to FNAL using official Tier0/Tier1 transfer mechanism
- 📌 Already getting subsystem data from local DAQs
- 📌 Prototype HCAL monitor running, trigger monitor under development
- 📌 ROC members working to develop data quality infrastructure for CMS

Future plan for ROC leads to LHC@FNAL



To be built on first floor of Wilson Hall, will allow remote participation in detector and accelerator operation



Three main functions for operations center:

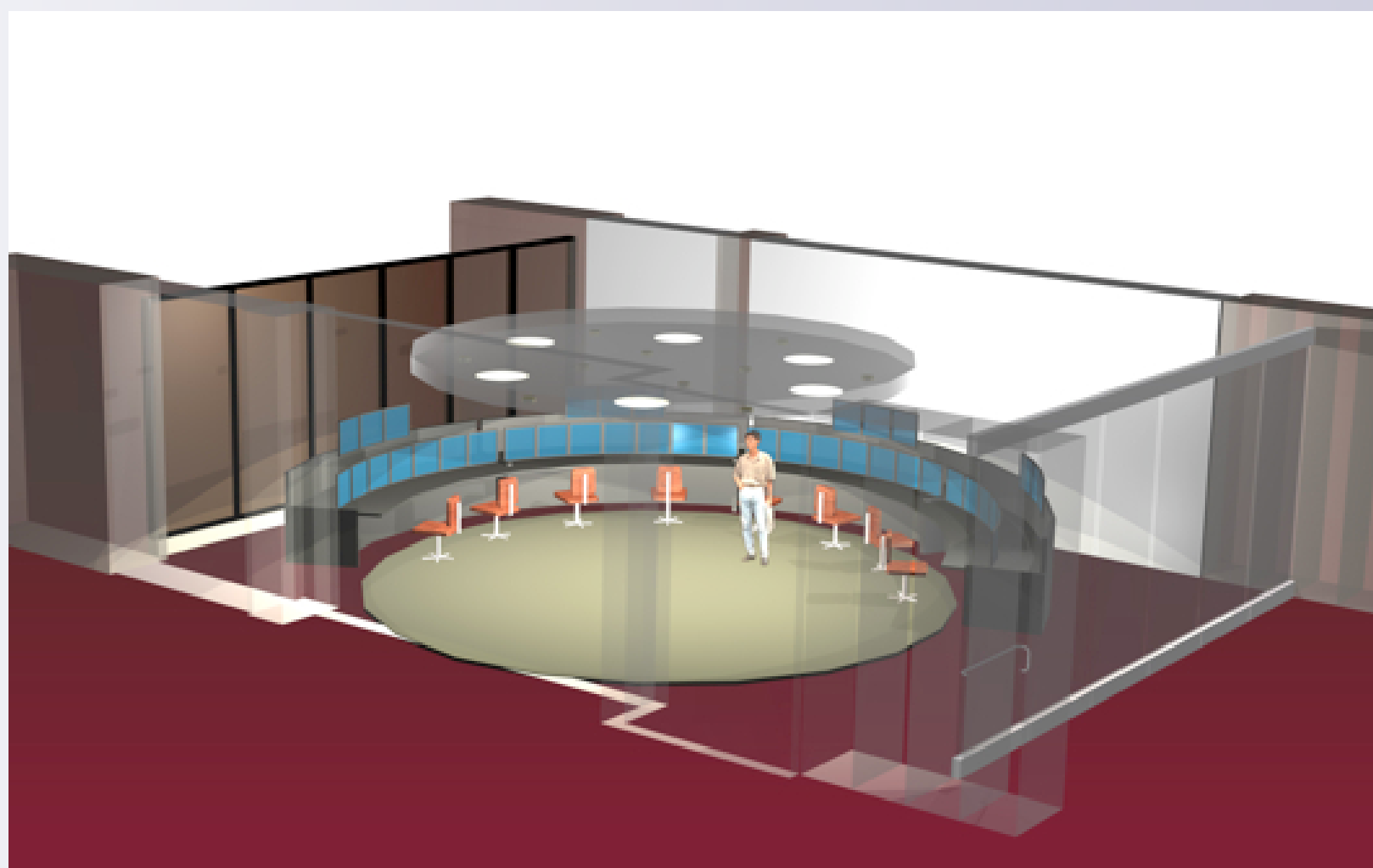
1. Access to information similar to what is available in CERN control rooms, with similar equipment
2. Means of communication between CERN and the LHC community in North America
3. Outreach: visitors will be able to see firsthand what is going on at the LHC



accelerator and detector
experts working side-by-side

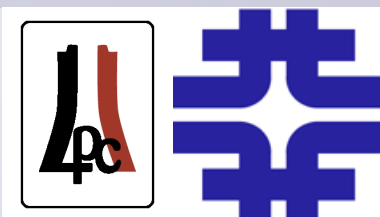


-  Approved by director in Spring 2006
-  Construction should begin soon and be complete in time for commissioning and operations for the start of data-taking in 2007





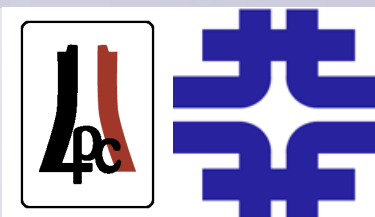
LPC Physics Group













- Recently formed Physics group, led by Boaz Klima
- “It’s our job at the LPC to create an environment in which everyone can get help and support whenever they are ready for physics” - (Boaz)
- Kicked off with a workshop last Fall
- Some topics discussed in recent meetings:
 - Plans for low luminosity running
 - qqH, dijet resonances, dimuon resonances, Higgs $\rightarrow \tau \tau$
 - ID/Trigger/Simulation - connection to other LPC groups
 - Theory: Getting Ready for SUSY



Things to come...



-  Many educational/training opportunities this summer
-  Expecting over 50 visitors this summer
-  Software Tutorials
-  MTCC/Test Beam workshop

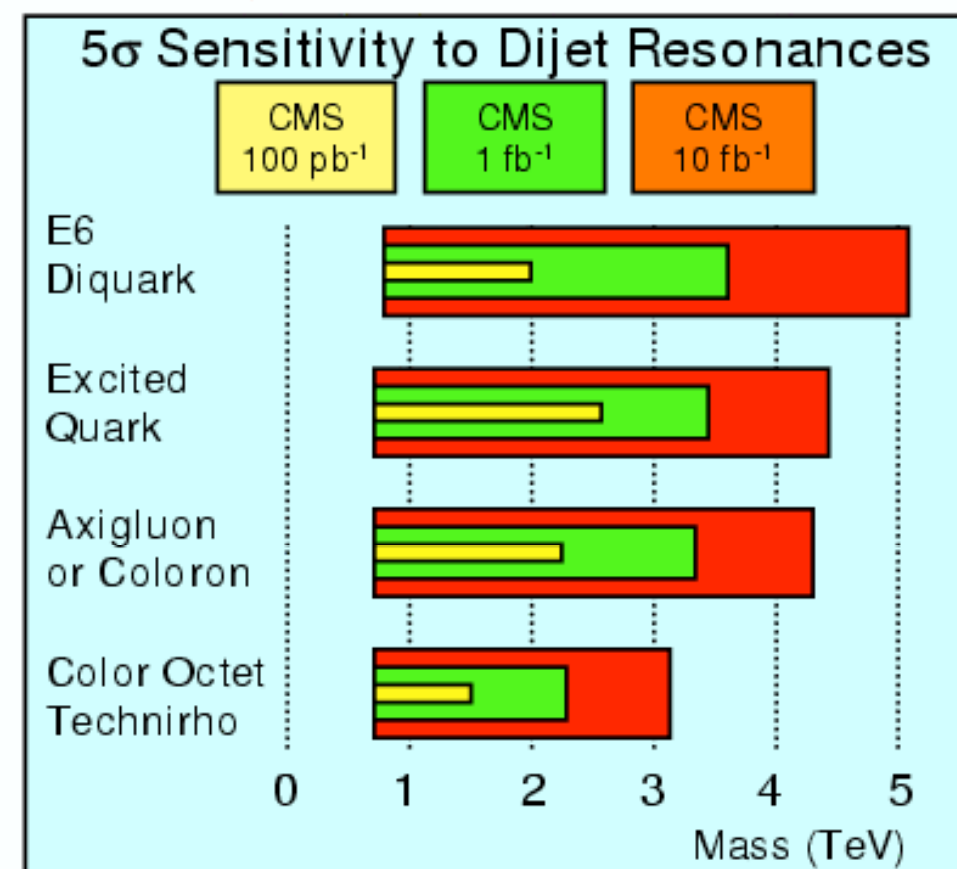
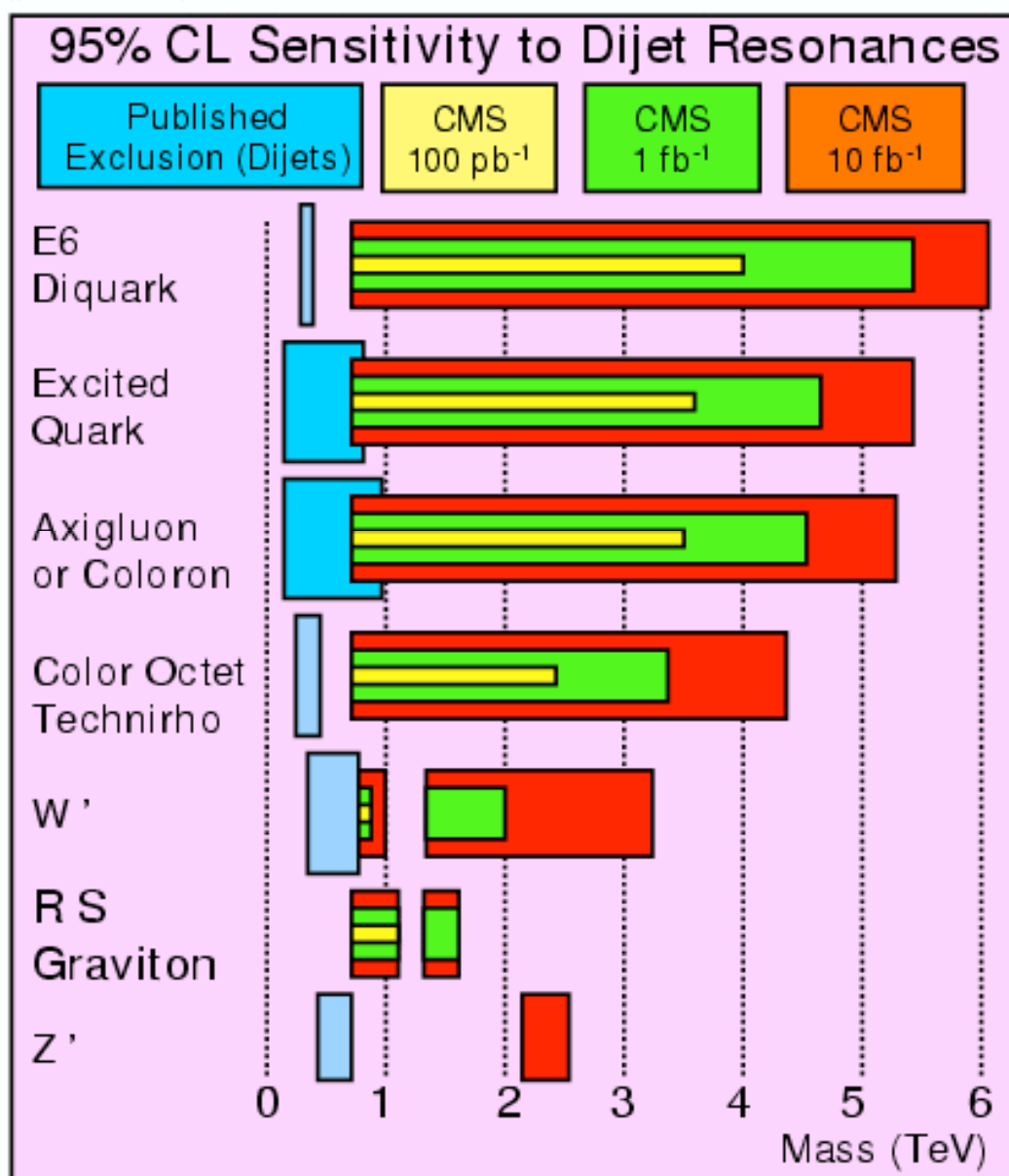
-  The LPC is gaining momentum
-  LPC groups are playing significant roles and making important contributions to CMS
-  Many LPC members have taken leadership positions within international CMS
-  LPC groups can help you get started with CMS and help prepare you to be ready for Day 1
-  ROC and LHC@FNAL will keep FNAL closely connected to CMS data-taking
-  The coming years should be very exciting.
Come and join us!



BACKUP



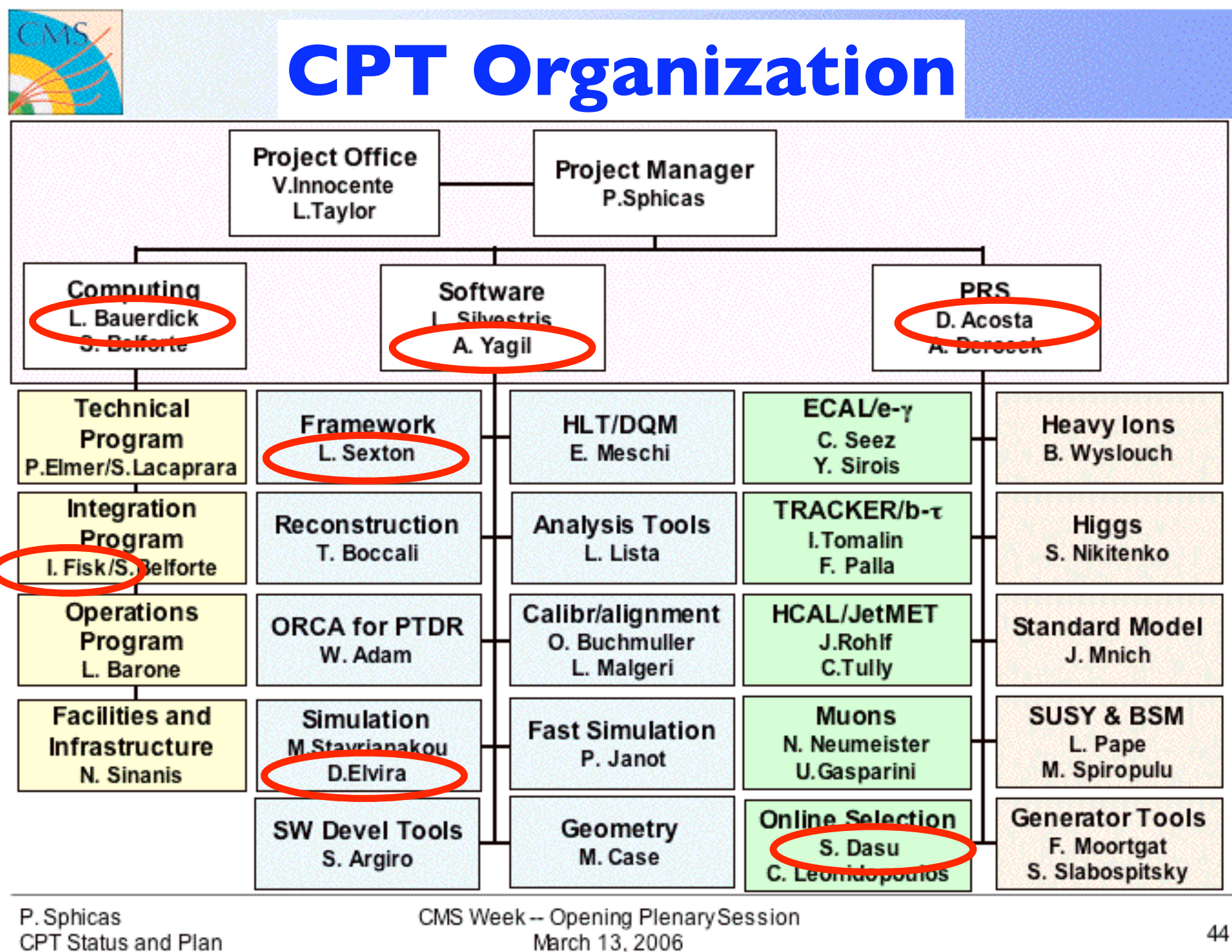
Sensitivity to Dijet Resonance Models



- CMS can exclude each of the models in some mass range.
- CMS can discover the strongly produced models up to many TeV.

Robert Harris, Fermilab

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Many LPC members in CMS leadership positions